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13. ABSTRACT (Maximum 200 words)
Following the completion of the thesis research of Dr. Craig Halvorson, a new graduate student, Jon McElvain, has been supported under this AFOSR ASSERT program. McElvain has focused his attention on the THG spectra of a number of polymers synthesized under the AFOSR program.

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(F91 ASSERT)
"Conjugated Polymers with Degenerate Ground State: The Route to High Performance NLO Response"

Principal Investigators:
Professor Alan J. Heeger

Administering Unit:
Institute for Polymers and Organic Solids
University of California at Santa Barbara
Santa Barbara, CA 93106

Summary of Progress

Following the completion of the thesis research of Dr. Craig Halvorson, a new graduate student, Jon McElvain, has been supported under this AFOSR ASSERT program. McElvain has fiocused his attention on the THG spectra of a number of polymers synthesized under the AFOSR program.

Annual Technical Report

I. Research objectives

Based upon our experimental and theoretical results as outlined in Section II (Background Information), we have concluded that the existence of a degenerate ground state is an important criterion for c[illegible]ga[illegible] polymers with large third order NLO response

--- $\chi^{(3)}(-3\omega,\omega,\omega,\omega) \approx 10^{-7}$ esu ---

since the degenerate ground state enables the virtual S-$\bar{S}$ intermediate A_g state mechanism.

The "ideal" material will therefore satisfy the following criteria:

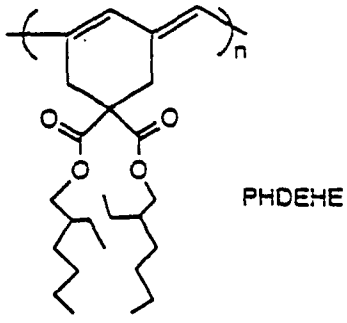
- **π-Conjugated polymer with a degenerate ground state**
- **Energy gap greater than 2 eV (for good transparency)**
- **No side chains (no dilution to ensure high π-electron density)**
- **Processible (optical quality thin films)**
- **Oriented and ordered (anisotropy).**

The goal of the proposed research is to achieve this "ideal" material. The research program has been designed and directed toward this goal.

II. Status of Research: Significant accomplishments and Progress toward stated goals

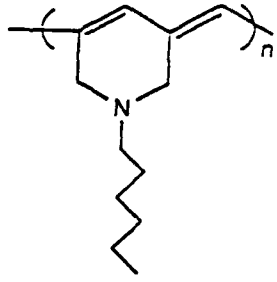
McElvain has mastered all the techniques available in our NLO laboratory, including THG measurements (as a function of pump frequency) and two-photon absorption measurtements using time resolve photo-thermal deflection measurements.

He is currently focusing his attention on the following polymer systems:

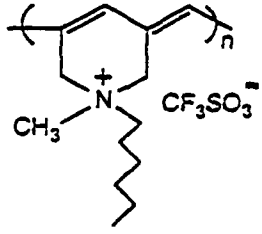


PHDEHE

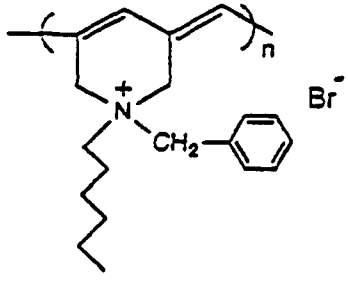
Poly(heptadiyne ethyl hexyl ester)



PDPHA Poly(dipropargyl hexylamine)



PDPMHAT Poly(dipropargyl methyl hexylamine triflate)



PDPBZHAB Poly(dipropargyl benzyl hexylamine bromide)

III. Articles published and/or in press

None

IV. Participating professionals

McElvain is working closely with Dr. Craig Halvorson

Advanced Degrees awarded:

Dr. Craig Halvorson, PhD, June 1993

Thesis title: Third Order Nonlinear Optical Effects in Conjugated Polymers

V. Interactions

Not applicable

VI. Patents, patent disclosures and specfic applications resulting from this research effort.

Patents: None

Patent disclosures: None

Specfic applications resulting from this research effort:

Based on Halvorson's thesis work, we concluded that a parallel architecture for an optical computer with short optical pathlengths can be used with considerable advantage. This concept was subsequently implemented by the demonstration of an optical image processor based upon the poly(1,6-heptadiyne diester) which carries out image correlations in 160 fs. This optical computer has achieved peak processing rates of $3x10^{16}$ operations per second, which is the fastest processing rate yet achieved.